

ENGINE HARMONIZATION WORKING GROUP (EHWG)
RECOMMENDATIONS FOR DISPOSITION OF CERTAIN COMMENTS
TO THE BIRD INGESTION NPRM

The EHWG was tasked with providing recommendations for disposition of comments received on the NPRM for 33.76 Bird Ingestion Standards. The task group covered four significant subject areas for which comments were received. These subject areas are 1) the JAA NPA intermediate flocking bird requirement of JAR E 800 (b)(2); 2) the Critical Ingestion Parameter (CIP) tolerance bands; 3) high speed operations below 10,000 ft. altitude; and 4) the validity and completeness of the database, and the method which the data was utilized.

The EHWG recommends that the FAA disposition the NPRM comments which fall into these categories as follows:

1. JAA NPA Intermediate Flocking Bird Requirement JAR E 800 (b)(2):

There is a general EHWG understanding that this requirement, in some form, will be adopted into JAR E. JAA's stated objective is to ensure that new engines will have the same integrity as current in-service engines against this bird threat. There is also general agreement that both JAR E and FAR Part 33 should eventually be harmonized relative to this issue.

It is also noted that the proposed requirement in its current form has not been optimized for its stated purpose. Consequently it is recommended that FAR 33 should not incorporate this provision at this time. Therefore, FAA should agree to work with JAA and industry to further study the intermediate flocking bird threat in service, and develop a suitable requirement to replace the current NPA 12% unbalance criteria, and revise 33.76 in a future rulemaking effort as appropriate.

[Note: JAA will continue to require compliance with draft JAR E 800 (b)(2) for engine certification purposes, and will maintain this requirement within the NPA for bird ingestion standards.]

2. Critical Ingestion Parameter (CIP):

There was general agreement that a new definition and a new AC guidance paragraph are necessary to put the proper perspective on what a CIP is, and how it is utilized for certification test/compliance purposes.

It is recommended that the following new definition be incorporated into the AC:

“Critical Impact Parameter: A parameter used to characterize the state of stress, strain, deflection, twist, or other condition which will result in the maximum impact damage to the engine for the prescribed bird ingestion condition.”

It is recommended that the following new AC paragraph be incorporated into the AC:

“GENERAL:

XX. Critical Impact Parameter (CIP): The parameter is generally a function of such things as bird mass, bird velocity, fan/rotor speed, impact location, and fan/rotor blade geometry. The state of maximum impact damage to the engine is relative to the ability to meet the criteria of Section 33.76. The CIP for most modern turbofan engines is fan blade leading edge stress, although other features or parameters may be more critical as a function of operating conditions or basic design. For turboprop and turbojet engines, a core feature will most likely be the critical consideration. Regardless of engine design, the most limiting parameter should be identified and understood prior to any demonstration, as any unplanned variations in controlling test parameters will be evaluated for the effect on the CIP and 33.76 requirements.

(1) Example Considerations for Determining the CIP: For turbofan first stage fan blades, increasing the bird velocity or bird mass will increase the slice mass, and could shift the CIP from leading edge stress to blade root stress. For fan blades with part span shrouds, it may be blade deflection that produces shroud shingling and either thrust loss or a blade fracture that could be limiting. For unshrouded wide chord fan blades it may be the twist of the blade in the dovetail that allows it to impact the trailing blade resulting in trailing blade damage.

(2) CIP Tolerance: For certification tests, the CIP variation should not be greater than 10% as a function of any deviations in test plan controlling parameters.”

3. High Speed Operations Below 10,000 ft. Altitude:

Overall consensus is that additional review outside the scope of this comment disposition phase will be necessary to completely evaluate the subject. Comments within EHWG ranged from a need to change the rule now to accommodate higher bird speeds, to a belief that the 200 kts. default is acceptable as is with no changes necessary. Therefore, EHWG recommends that the NPRM go forward retaining the 200 kts. default speed for large bird, and retain the criticality analysis approach for medium bird speed. It is also recommended that a new AC section be incorporated to help identify situations where the 200 kts. default speed for large bird may not provide for the desired level of evaluation for the identified CIP's (see proposed AC text below). It is also recommended that a future rulemaking study be initiated to review the basis for the large bird speed requirements within the current proposal. The basis for this recommendation is that the medium bird speed criticality analysis requirement is adequate with respect to current aircraft operations; that the 200 kts. large bird speed is appropriate for many designs; and

should be adequate until a further review of the large bird requirements is completed; and that the new AC section will make ACOs and Applicants aware of this potential issue."

EHWG recommends the following new AC paragraph be incorporated:

"The 200 kts. ingestion speed for the large bird requirement was selected as the optimum speed to accommodate, within a single demonstration, the various critical ingestion parameters (CIP) associated with typical turbofan engine designs currently in service. However, for a specific engine design, an aircraft speed other than 200 kts. may be more appropriate when considering the overall criteria of 33.76(b). Therefore, if the applicant identifies and substantiates that a bird speed other than 200 kts. is more conservative or more completely evaluates the proposed design, then the tests and analyses required under 33.76(b) may be conducted at that ingestion speed and be so noted in the certification documentation as an equivalent level of safety finding."

4. Data Base Issues:

EHWG general consensus is that, as a matter of near term need, all appropriate sources of data should be studied to 1) define the current bird threat (all sizes; larger flocking birds as top priority), and evaluate recent trends and consider reasonably predictable changes to the current threat; 2) take a closer look at flocking birds larger than those addressed by the current rule; and 3) evaluate the match between the 33.76 rule and the above reviews, and also determine whether the basic design of the rule was accomplished in the most appropriate manner. In summary, it is recommended that FAA work with industry and JAA to further study these issues and update the rule if necessary. It is also noted that the situation should be periodically assessed, using all appropriate data sources, so as to maintain a continued awareness of threats in service.

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